New Hampshire Volunteer Lake Assessment Program

2002 Bi-Annual Report for
Canobie Lake
Windham

NHDES
Water Division
Watershed Management Bureau
6 Hazen Drive
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NEW HAMPSHIRE DEPARTMENT OF Environmental Services

2002

OBSERVATIONS & RECOMMENDATIONS

Welcome to the New Hampshire Volunteer Lake Assessment Program! As your association continues to participate in VLAP over the years, the database created for your lake/pond will help your association track water quality trends and will ultimately enable the association and DES to identify potential sources of pollutants from the watershed that may affect water quality.

As a rule of thumb, *please* try to sample at least once per month during the summer months (June, July, and August). In addition, it may be necessary to conduct stormwater sampling at multiple locations along a stream using the bracketing technique to pinpoint sources of pollution, and baseline studies could involve bi-weekly or monthly sampling for an extended period of time. DES will let you know if this type of sampling is appropriate.

We understand that future sampling will depend upon volunteer availability, and the associations' water monitoring goals and funding availability. We would like to point out that **water quality trend analysis is not feasible with only a few data points.** It will take many years to develop a statistically sound set of water quality baseline data. Specifically, after 10 consecutive years of participation in the program, we will be able to analyze the in-lake data with a simple statistical test to determine if there has been a significant change in the annual mean chlorophyll-a concentration, Secchi-disk transparency reading, and phosphorus concentration. Therefore, frequent and consistent sampling will ensure useful data for future analyses.

Please contact the VLAP Coordinator early this spring to schedule our annual lake visit. **It would be to your advantage to have our visit early in the summer to refresh your sampling skills!**

Finally, please remember that one of your most important responsibilities as a volunteer monitor is to educate your association, community, and town officials to let them know the quality of your lake/pond and what can be done to protect it!

After reviewing data collected from **CANOBIE LAKE,** the program coordinators recommend the following actions.

FIGURE INTERPRETATION

- **Figure 1 and Table 1:** The graphs in Figure 1 (Appendix A) show the historical and current year chlorophyll-a concentration in the water column. Table 1 (Appendix B) lists the maximum, minimum, and mean concentration for each sampling season that the lake/pond has been monitored through the program.

  Chlorophyll-a, a pigment naturally found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a and are naturally found in lake ecosystems, the chlorophyll-a concentration found in the water gives an estimation of the concentration of algae or lake productivity. The mean (average) summer chlorophyll-a concentration for New Hamsphire's lakes and ponds is 7.02 ug/L.

  Similar to the summer of 2001, the summer of 2002 was filled with many warm and sunny days and there was a lower than normal amount of rainfall during the latter-half of the summer. The combination of these factors resulted in relatively warm surface waters throughout the state. The lack of fresh water to the lakes/ponds reduced the rate of flushing which may have resulted in water stagnation. Due to these conditions, many lakes and ponds experienced increased algae growth, including filamentous green algae (the billowy clouds of green algae typically seen floating near shore), and some lakes/ponds experienced nuisance cyanobacteria (blue-green algae) blooms.

  The current year data (the top graph) show that the chlorophyll-a concentration in September was ***less than*** the state mean. We hope this continues!

  After 10 consecutive years of sample collection, we will be able to conduct a statistical analysis of the historic data to objectively determine if there has been a significant change (either overall increase or decrease) in the annual mean chlorophyll-a concentration since monitoring began.

  While algae is naturally present in all lakes/ponds, an excessive or increasing amount of any type is not welcomed. In freshwater lakes/ponds, phosphorus is the nutrient that algae depend upon for growth. Therefore, algal concentrations may increase when there is an increase in nonpoint sources of nutrient loading from the watershed, or in-lake sources of phosphorus loading (such as phosphorus releases from the sediments). It is important to continually educate residents about how activities within the watershed can affect phosphorus loading and lake quality.

- **Figure 2 and Table 3:** The graphs in Figure 2 (Appendix A) show historical and current year data for lake/pond transparency. Table 3 lists the maximum, minimum and mean transparency data for each sampling season that the lake/pond has been monitored through the program.

  Volunteer monitors use the Secchi-disk, a 20 cm disk with alternating black and white quadrants, to measure water clarity (how far a person can see into the water). Transparency, a measure of water clarity, can be affected by the amount of algae and sediment from erosion, as well as the natural colors of the water. The mean (average) summer transparency for New Hampshire's lakes and ponds is 3.7 meters.

  Two different weather related patterns occurred this past spring and summer that influenced lake quality during the summer season.

  In late May and early June of 2002, numerous rainstorms occurred. Stormwater runoff associated with these rainstorms may have increased phosphorus loading, and the amount of soil particles washed into waterbodies throughout the state. Some lakes and ponds experienced lower than typical transparency readings during late May and early June.

  However, similar to the 2001 sampling season, the lower than average amount of rainfall and the warmer temperatures during the latter-half of the summer resulted in a few lakes/ponds reporting their best-ever Secchi-disk readings in July and August (a time when we often observe reduced clarity due to increased algal growth)!

  The current year data (the top graph) show that the in-lake transparency in September was approximately two meters ***greater than*** the state mean!

  After 10 consecutive years of sample collection, we will be able to conduct a statistical analysis of the historic data to objectively determine if there has been a significant change (either overall increase or overall decrease) in the annual mean transparency since monitoring began.

  Typically, high intensity rainfall causes erosion of sediments into lakes/ponds and streams, thus decreasing clarity. Efforts should continually be made to stabilize stream banks, lake/pond shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the lake/pond. Guides to Best Management Practices designed to reduce, and possibly even eliminate, nonpoint source pollutants, such as sediment loading, are available from NHDES upon request.

- **Figure 3 and Table 8:** The graphs in Figure 3 (Appendix A) show the amounts of phosphorus in the epilimnion (the upper layer) and the hypolimnion (the lower layer); the inset graphs show current year data. Table 8 (Appendix B) lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the lake/pond has joined the program.

  Phosphorus is the limiting nutrient for plant and algae growth in New Hampshire's freshwater lakes and ponds. Too much phosphorus in a lake/pond can lead to increases in plant and algal growth over time. The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 11 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.

  The current year data for the epilimnion (the top inset graph) show that the total phosphorus concentration in September was ***less than*** the state median.

  The current year data for the hypolimnion (the bottom inset graph) show that the total phosphorus concentration in September was ***greater than*** the state median, and much greater than the concentration in the epilimnion.

  The turbidity of the hypolimnion (lower layer) sample was elevated on the **September** sampling event was elevated. This suggests that the lake/pond bottom may have been disturbed by the anchor while sampling (this is likely since drifting occurred while at the deep spot). When the lake/pond bottom is disturbed, sediment, which typically contains attached phosphorus, is released into the water column. When collecting the hypolimnion sample, please check to make sure that there is no sediment in the Kemmerer Bottle before filling the sample bottles.

  One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about its sources and how excessive amounts can adversely impact the ecology and value of lakes and ponds. Phosphorus sources within a lake or pond's watershed typically include septic systems, animal waste, lawn fertilizer, road and construction erosion, and natural wetlands. If you would like to educate watershed residents about how they can help to reduce phosphorus loading into the lake/pond, please contact the VLAP Coordinator.

TABLE INTERPRETATION

- **Table 2: Phytoplankton**
  Table 2 lists the current and historic phytoplankton species observed in the lake/pond. The dominant phytoplankton species observed this year were ***Ceratium*** **(a dinoflagellate)** ***and Mallomonas*** **(a golden-brown algae).**

  Phytoplankton populations undergo a natural succession during the growing season (Please refer to page 12 of the "Biological Monitoring Parameters" section of this report for a more detailed explanation regarding seasonal plankton succession). Diatoms and golden-brown algae are typical in New Hampshire's less productive lakes and ponds. An overabundance of cyanobacteria (previously referred to as blue-green algae) indicates that there may be an excessive total phosphorus concentration in the lake/pond, or that the ecology is out of balance. Some species of cyanobacteria can be toxic to livestock, pets, wildlife, and humans. (Please refer to pages 12 - 14 of the "Biological Monitoring Parameters" section of this report for a more detailed explanation regarding cyanobacteria).

- **Table 4: pH**
  Table 4 (Appendix B) presents the in-lake and tributary current year and historical pH data.

  pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 5.5 severely limits the growth and reproduction of fish. A pH between 6.5 and 7.0 is ideal for fish. The mean pH value for the epilimnion (upper layer) in New Hampshire's lakes and ponds is 6.5, which indicates that the surface waters in state are slightly acidic. For a more detailed explanation regarding pH, please refer to page 16 of the "Chemical Monitoring Parameters" section of this report.

  The pH ***at the deep spot*** on the September sampling event ranged from 6.48 to 7.16, which means that the lake pH should support a healthy fish population.

  Due to the presence of granite bedrock in the state and the deposition of acid rain, there is not much that can be done to effectively increase lake/pond pH.

- **Table 5: Acid Neutralizing Capacity**
  Table 5 in Appendix B presents the current year and historic epilimnetic ANC for each year the lake/pond has been monitored through VLAP.

Buffering capacity or ANC describes the ability of a solution to resist changes in pH by neutralizing the acidic input to the lake. For a more detailed explanation, please refer to page 16 of the "Chemical Monitoring Parameters" section of this report.

The Acid Neutralizing Capacity (ANC) of the ***epilimnion*** (the upper layer) was 15.70 mg/L as $CaCO_3$, which is ***much greater*** the state mean of 6.7 mg/L (Table 5). Specifically, this means that the lake/pond is ***"not vulnerable"*** to acidic inputs (such as acid precipitation).

- **Table 6: Conductivity**

Table 6 in Appendix B presents the current and historic conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current. For a more detailed explanation, please refer to page 16 of the "Chemical Monitoring Parameters" section of this report.

The conductivity at the deep spot of the lake/pond ranged from 270 to 277 uMhos/cm, which is relatively ***high***. Typically conductivity levels greater than 100 uMhos/cm indicate the influence of human activities on surface water quality. These activities include septic system leachate, agricultural runoff, iron deposits, and road runoff (which contains road salt during the spring snow melt). The high conductivity level in **Canobie Lake** is likely a result of the application of road salt on the roadways in the area during the winter.

- **Table 8: Total Phosphorus**

Table 8 in Appendix B presents the current year and historic total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae's ability to grow and reproduce. Please refer to page 17 of the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

Tributary sampling was not conducted on the September sampling event since all of the tributaries were dry. We recommend that your monitoring group sample the tributaries and the lake in late May or early June next season, during a period of high water, so that we can determine the quality of the water that flows into the lake.

- **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**

Table 9 in Appendix B shows the dissolved oxygen/temperature profile(s) for the 2002 sampling season. Table 10 shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

The dissolved oxygen concentration was ***low*** at the deep spot of the lake/pond (Table 10). As stratified lakes/ponds age, oxygen becomes ***depleted*** in the hypolimnion (the lower layer) by the process of decomposition. Specifically, the loss of oxygen in the hypolimnion results primarily from the process of biological breakdown of organic matter (i.e.; biological organisms use oxygen to break down organic matter), both in the water column and particularly at the bottom of the lake/pond where the water meets the sediment. When oxygen levels are depleted to less than 1 mg/L in the hypolimnion **(as it was this season)**, the phosphorus that is normally bound up in the sediment may be re-released into the water column.

The ***low*** oxygen level in the hypolimnion is a sign of the lake's/pond's ***aging*** and ***declining*** health. This year the DES biologist conducted the temperature/dissolved oxygen profile in ***September.*** We recommend that the annual biologist visit for the 2003 sampling season be scheduled during ***June*** so that we can determine if oxygen is depleted in the hypolimnion at the start of the sampling season.

- **Table 11: Turbidity**

  Table 11 in Appendix B lists the current year and historic data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to page 19 of the "Other Monitoring Parameters" section of this report for a more detailed explanation.

  As discussed previously, the turbidity of the hypolimnion (lower layer) sample was elevated on the **September** sampling event. This suggests that the lake/pond bottom may have been disturbed by the anchor or by the Kemmerer Bottle while sampling. When collecting the hypolimnion sample, please check to make sure that there is no sediment in the Kemmerer Bottle before filling the sample bottles. In addition, please make sure that you use an anchor with a sufficient amount of line to prevent drifting while sampling at the deep spot.

- **Table 12: Bacteria (*E.coli*)**

  Table 12 lists the current year data for bacteria *(E.coli)* testing. *E. coli* is a normal bacterium found in the large intestines in humans and other warm-blooded animals. *E.coli* is used as an indicator organism because it is easily cultured, and its presence in the water, in defined amounts, indicates that sewage **MAY** be present. If sewage is present in the water, potentially harmful pathogens may also be present. Please consult page 20 of the "Other Monitoring Parameters section of the report for the current standards for *E. coli* in surface waters. If residents are concerned about sources of *E.coli* such as septic system impacts, animal waste, or waterfowl waste, it is best to conduct *E. coli* testing when the water table is high or after rain events.

Bacteria concentrations were **low** at the all of the sites tested this season. We hope this trend continues!

NOTES

- Biologist's Note (7/4/02): The exact deep spot was not located. Some drifting occurred at the deep spot. The lake level is down. Approximately 10 weeks ago, the lake was treated with copper sulfate to reduce algal growth. An adult loon with fishing line coming out of its mouth and potentially a bobber attached to the body was observed. According to the volunteer monitors, the Loon Preservation Society has been contacted.

USEFUL RESOURCES

Changes to the Comprehensive Shoreland Protection Act: 2001 Legislative Session, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/sp/sp-8.htm

Cyanobacteria in New Hampshire Waters Potential Dangers of Blue-Green Algae Blooms, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/wmb/wmb-10.htm

The Lake Pocket Book. Prepared by The Terrene Institute, 2000. (internet: www.terrene.org, phone 800-726-4853)

Managing Lakes and Reservoirs, Third Edition, 2001. Prepared by the North American Lake Management Society (NALMS) and the Terrene Institute in cooperation with the U.S. Environmental Protection Agency. Copies are available from NALMS (internet: www.nalms.org, phone 608-233-2836), and the Terrene Institute (internet: www.terrene.org, phone 800-726-4853)

Organizing Lake Users: A Practical Guide. Written by Gretchen Flock, Judith Taggart, and Harvey Olem. Copies are available form the Terrene Institute (internet: www.terrene.org, phone 800-726-4853)

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Proper Lawn Care in the Protected Shoreland: The Comprehensive Shoreland Protection Act, WD-SP-2, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-2.htm

Sand Dumping - Beach Construction, WD-BB-15, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-15.htm

Swimmers Itch, WD-BB-2, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-2.htm

Use of Lakes or Streams for Domestic Water Supply, WD-WSEB-1-11, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/ws/ws-1-11.htm

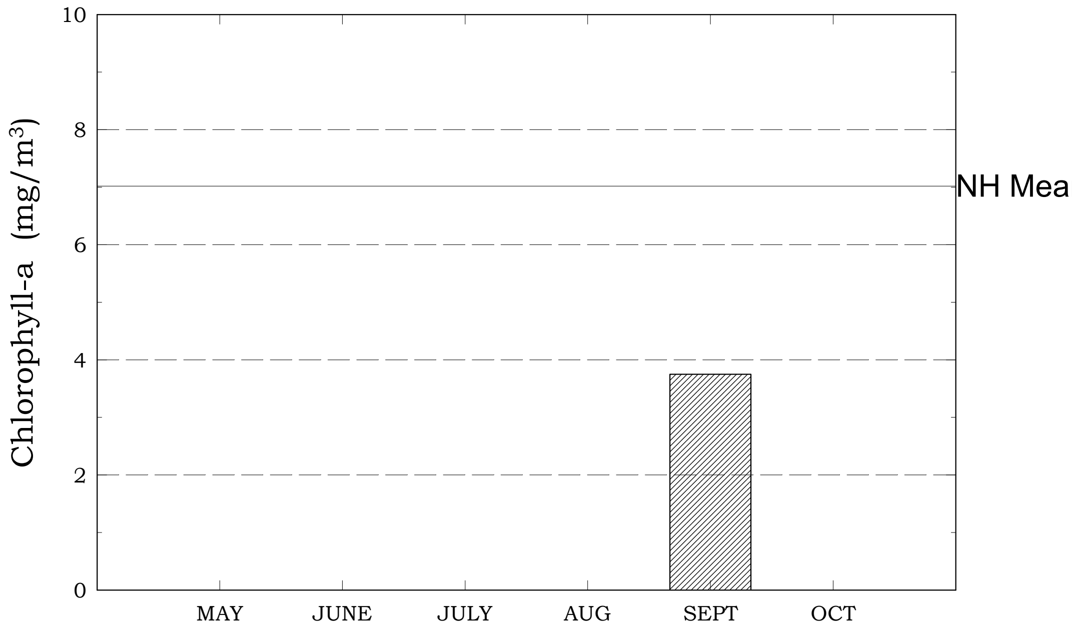
Water Milfoil, WD-BB-1, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-1.htm

Weed Watchers: An Association to Halt the Spread of Exotic Aquatic Plants, WD-BB-4, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-4.htm

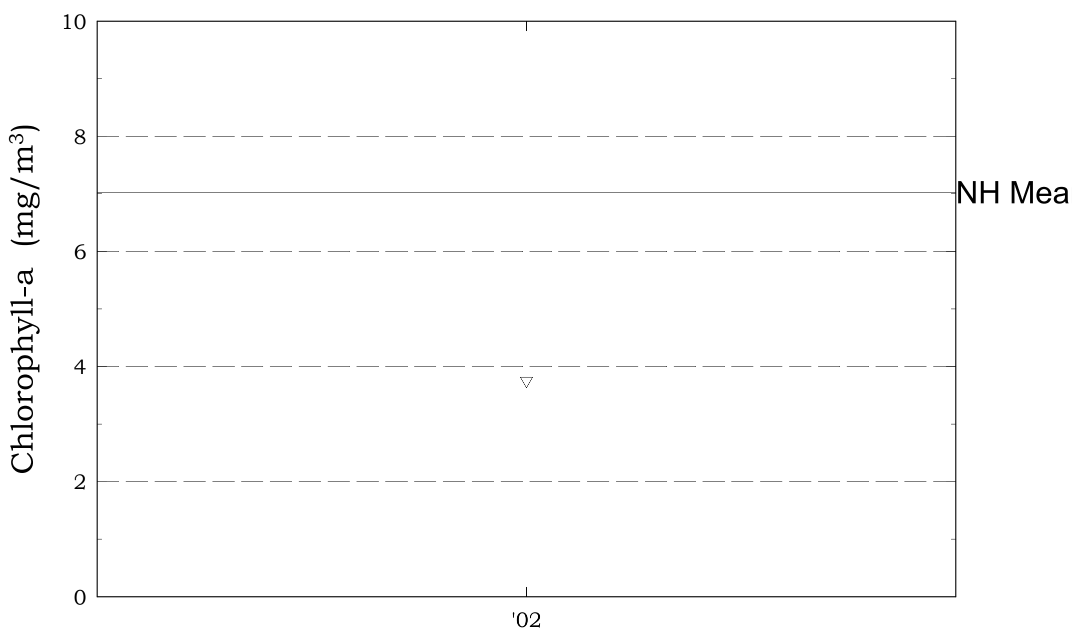
Appendix A: Graphs

Canobie Lake, Windham

Figure 1. Monthly and Historical Chlorophyll-a Results



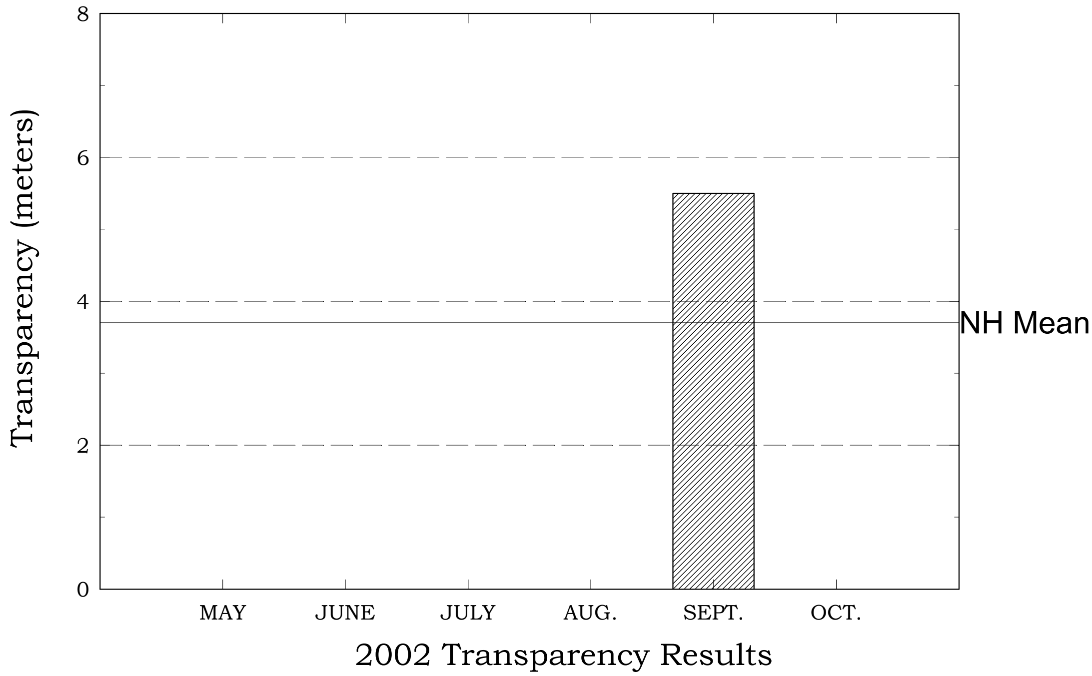
2002 Chlorophyll-a Results

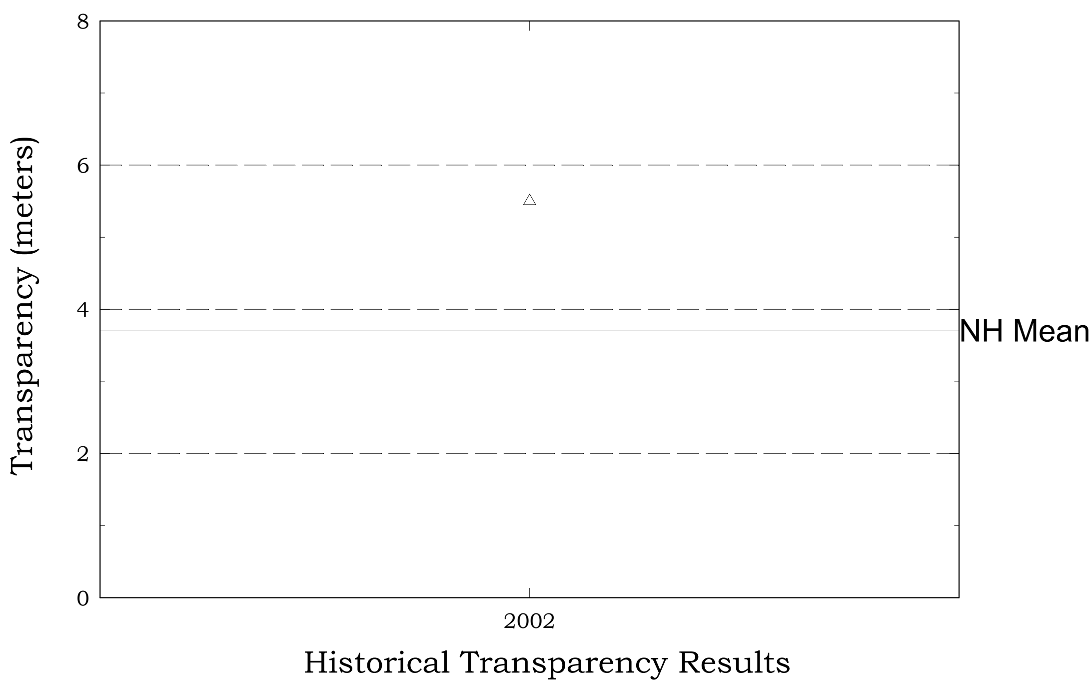


Historical Chlorophyll-a Results

Canobie Lake, Windham

Figure 2. Monthly and Historical Transparency Results





Canobie Lake, Windham

Figure 3. Monthly and Historical Total Phosphorus Data.